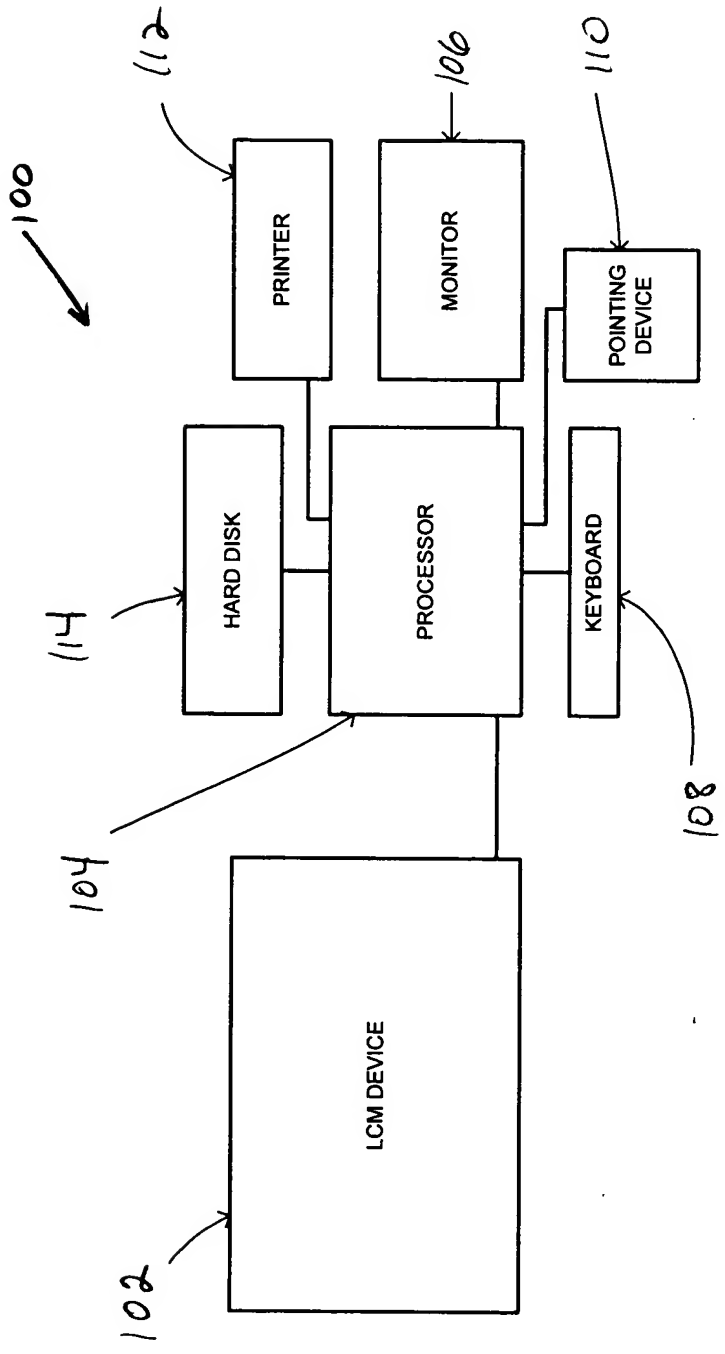
100
112
106
110
PRINTER
MONITOR
POINTING DEVICE
HARD DISK
PROCESSOR
KEYBOARD
114
104
108
LCM DEVICE
102

FIG. 1

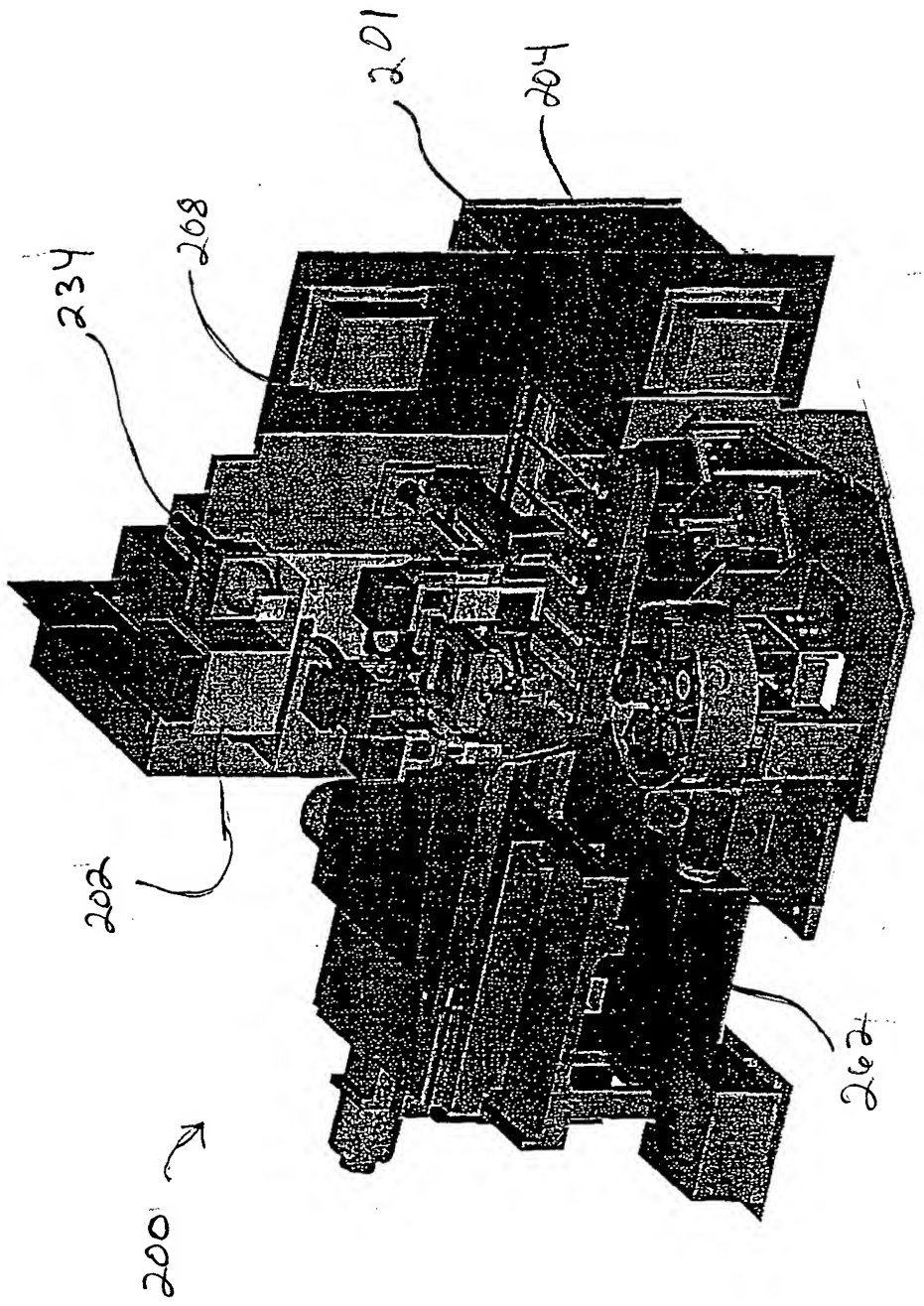

FIG. 2

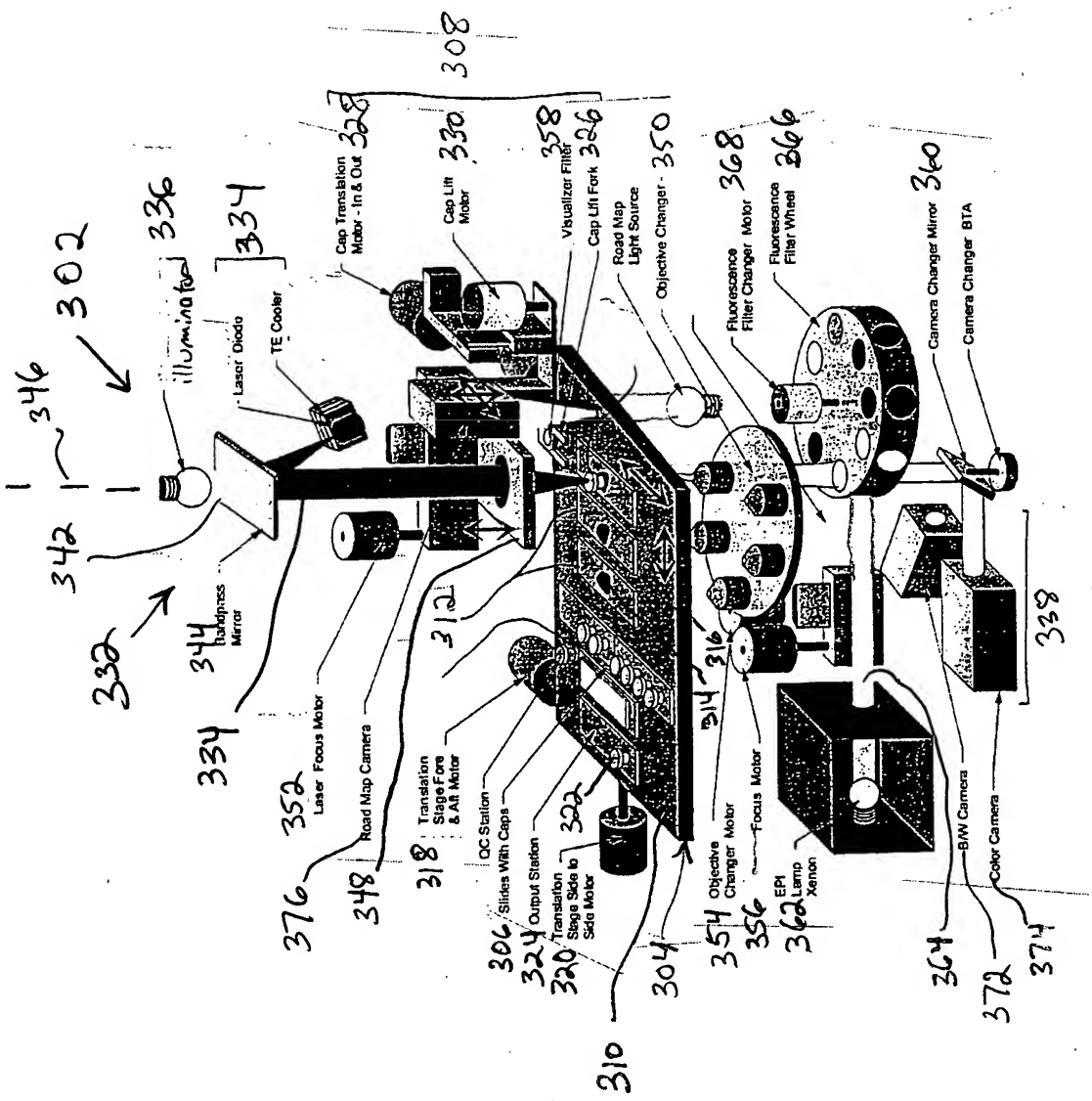
302
346
336
334
342
332
344
Illuminator
Laser Diode
TE Cooler
Beamsplitter Mirror
Cap Translation Motor - In & Out
Cap Lift Motor
Visualizer Filter
Cap Lift Fork
Road Map Light Source
Objective Changer
Fluorescence Filter Changer Motor
Fluorescence Filter Wheel
Camera Changer Mirror
Camera Changer BTA
Laser Focus Motor
Road Map Camera
Translation Stage Fore & Aft Motor
QC Station
Slides With Caps
Output Station
Translation Stage Side to Side Motor
Objective Changer Motor
Focus Motor
EPI Lamp Xenon
B/W Camera
Color Camera
308
328
330
358
326
350
368
366
360
352
348
318
312
316
314
322
324
320
306
310
304
354
356
362
364
372
374
376
338

FIG. 3

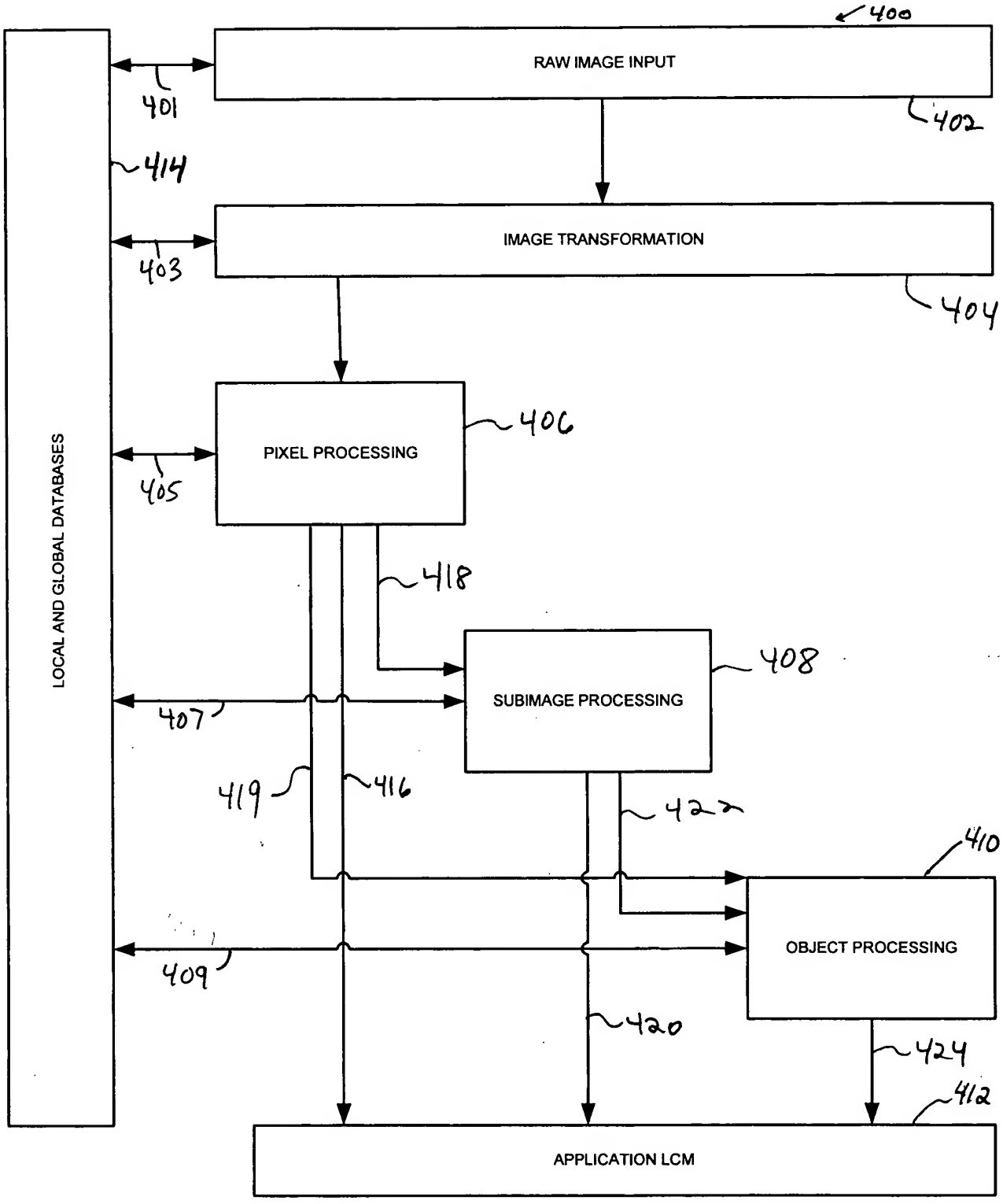
400
RAW IMAGE INPUT
401
402
414
IMAGE TRANSFORMATION
403
404
PIXEL PROCESSING
406
405
418
SUBIMAGE PROCESSING
408
407
419
416
422
410
OBJECT PROCESSING
409
420
424
412
APPLICATION LCM
LOCAL AND GLOBAL DATABASES

FIG. 4

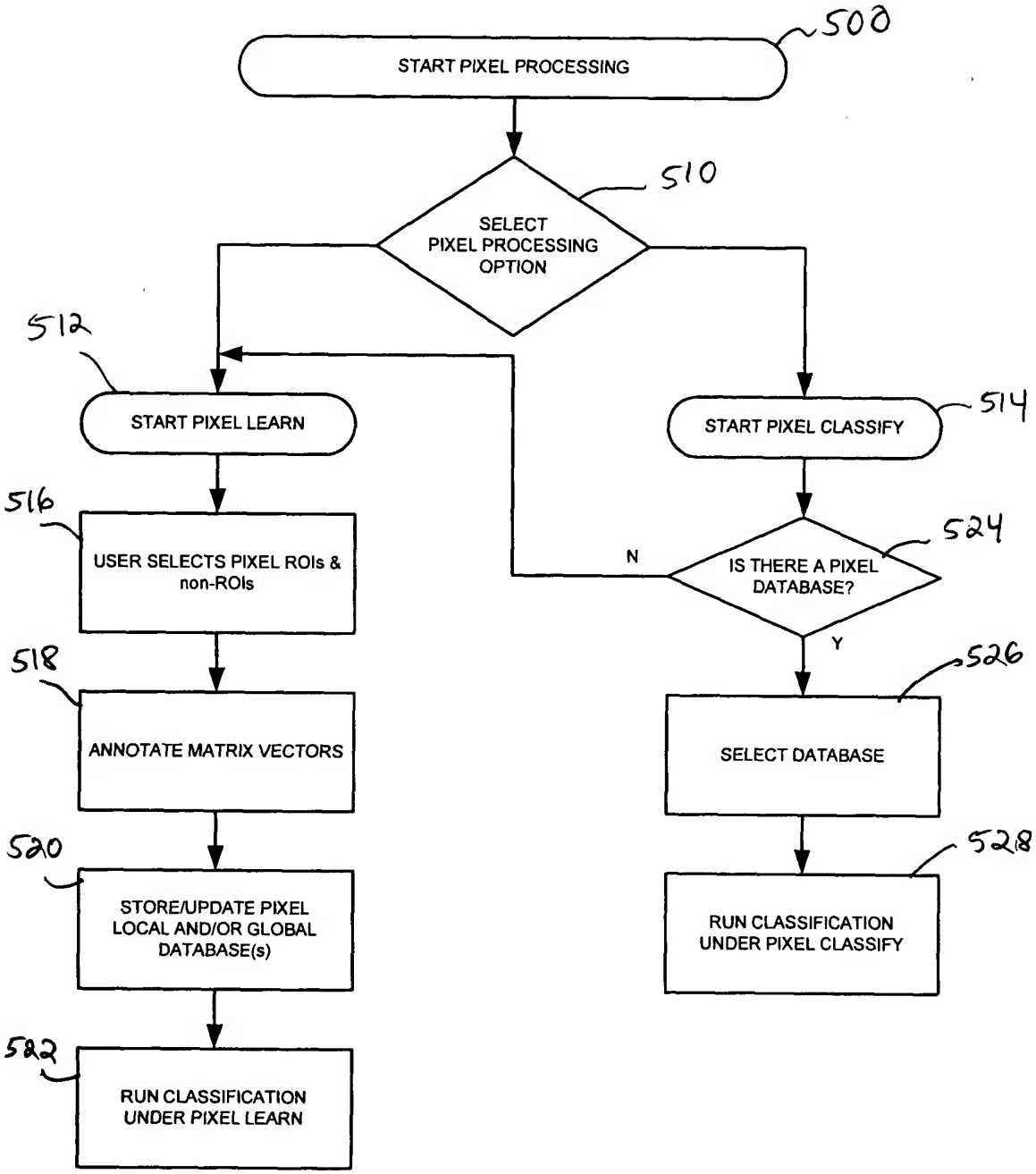
500
START PIXEL PROCESSING
510
SELECT PIXEL PROCESSING OPTION
512
START PIXEL LEARN
514
START PIXEL CLASSIFY
516
USER SELECTS PIXEL ROIs & non-ROIs
518
ANNOTATE MATRIX VECTORS
520
STORE/UPDATE PIXEL LOCAL AND/OR GLOBAL DATABASE(s)
522
RUN CLASSIFICATION UNDER PIXEL LEARN
524
IS THERE A PIXEL DATABASE?
N
Y
526
SELECT DATABASE
528
RUN CLASSIFICATION UNDER PIXEL CLASSIFY

FIG. 5

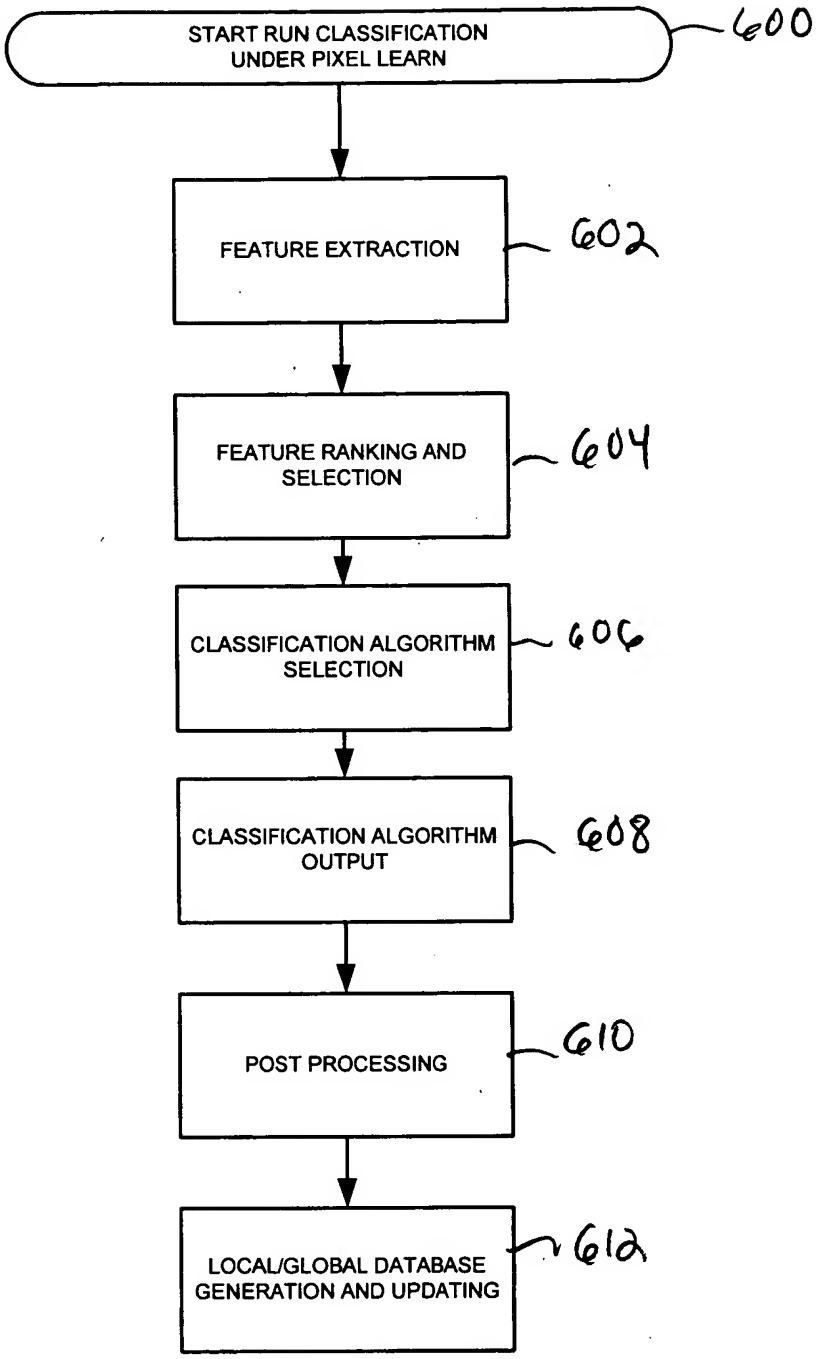
START RUN CLASSIFICATION UNDER PIXEL LEARN
600
FEATURE EXTRACTION
602
FEATURE RANKING AND SELECTION
604
CLASSIFICATION ALGORITHM SELECTION
606
CLASSIFICATION ALGORITHM OUTPUT
608
POST PROCESSING
610
LOCAL/GLOBAL DATABASE GENERATION AND UPDATING
612

FIG. 6

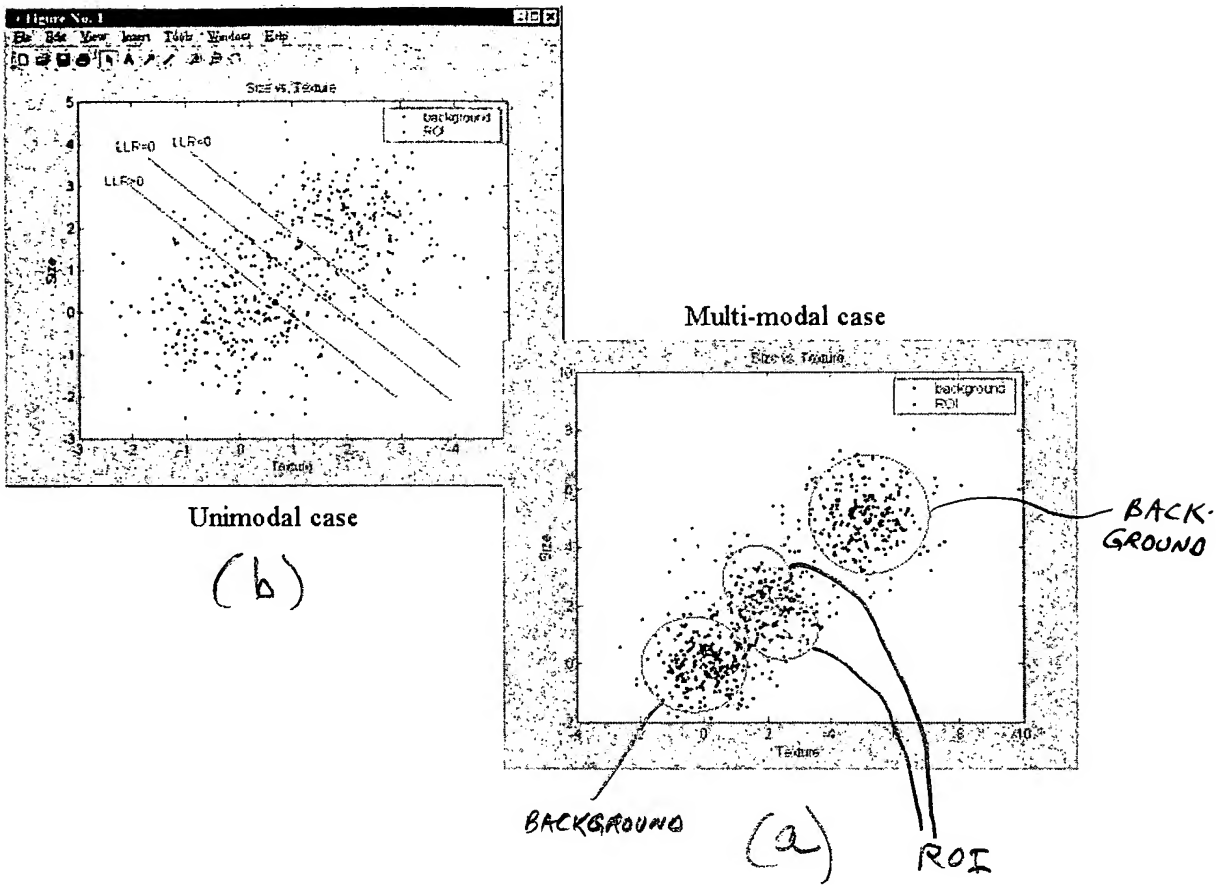
Size vs. Texture
background
ROI
LLR=0
LLR=0
LLR=0
Size
Texture
Unimodal case
(b)
Multi-modal case
Size vs. Texture
background
ROI
Size
Texture
BACK-GROUND
BACKGROUND
(a)
ROI

FIG 7

Results of Pixel Processing

FIG. 8A

After region labeling of the
binary image map (color denotes
a region identification number)

FIG 8B

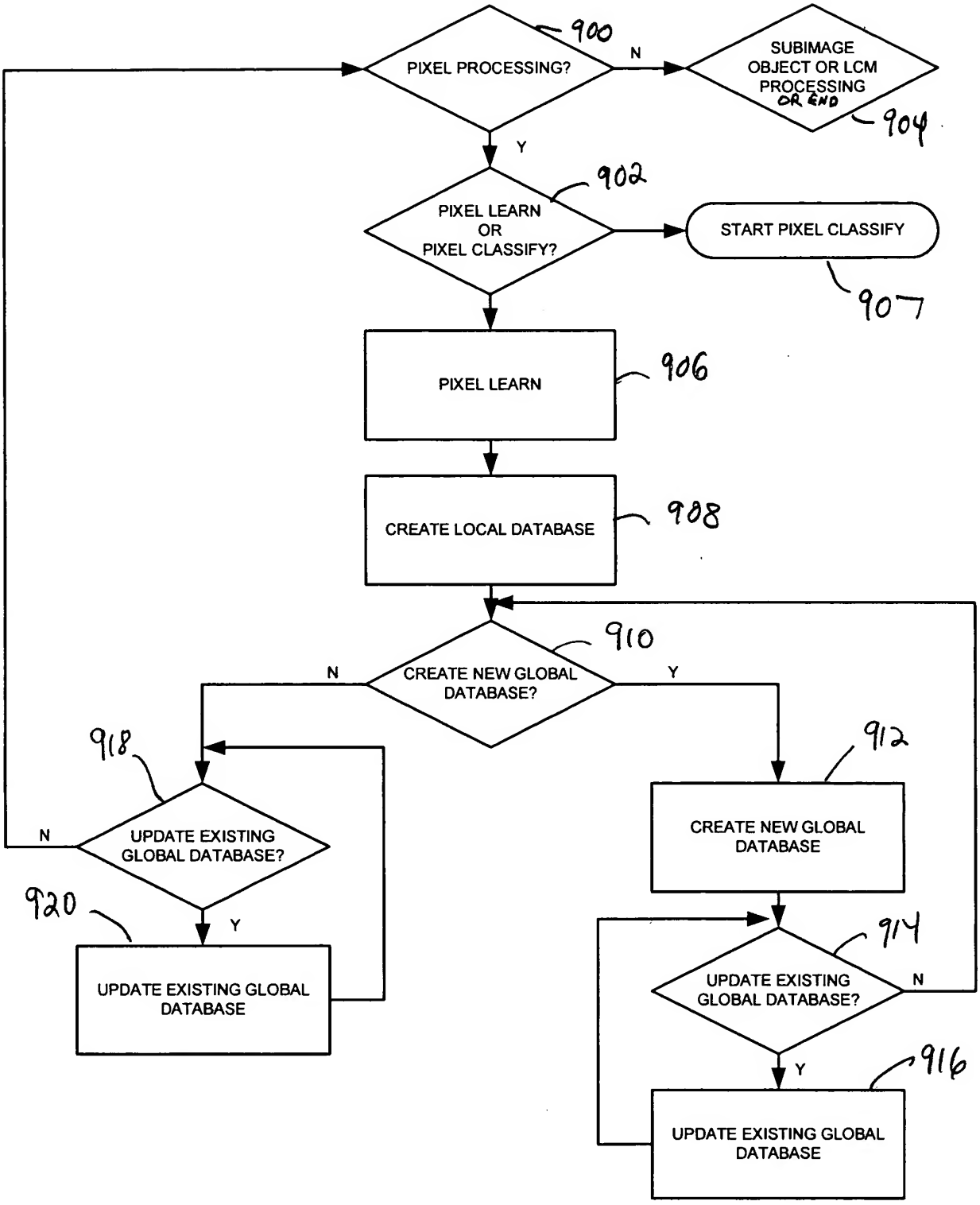
900
PIXEL PROCESSING?
N
SUBIMAGE OBJECT OR LCM PROCESSING OR END
904
Y
902
PIXEL LEARN OR PIXEL CLASSIFY?
START PIXEL CLASSIFY
907
PIXEL LEARN
906
CREATE LOCAL DATABASE
908
910
CREATE NEW GLOBAL DATABASE?
N
Y
918
UPDATE EXISTING GLOBAL DATABASE?
N
920
Y
UPDATE EXISTING GLOBAL DATABASE
912
CREATE NEW GLOBAL DATABASE
914
UPDATE EXISTING GLOBAL DATABASE?
N
Y
916
UPDATE EXISTING GLOBAL DATABASE

FIG. 9

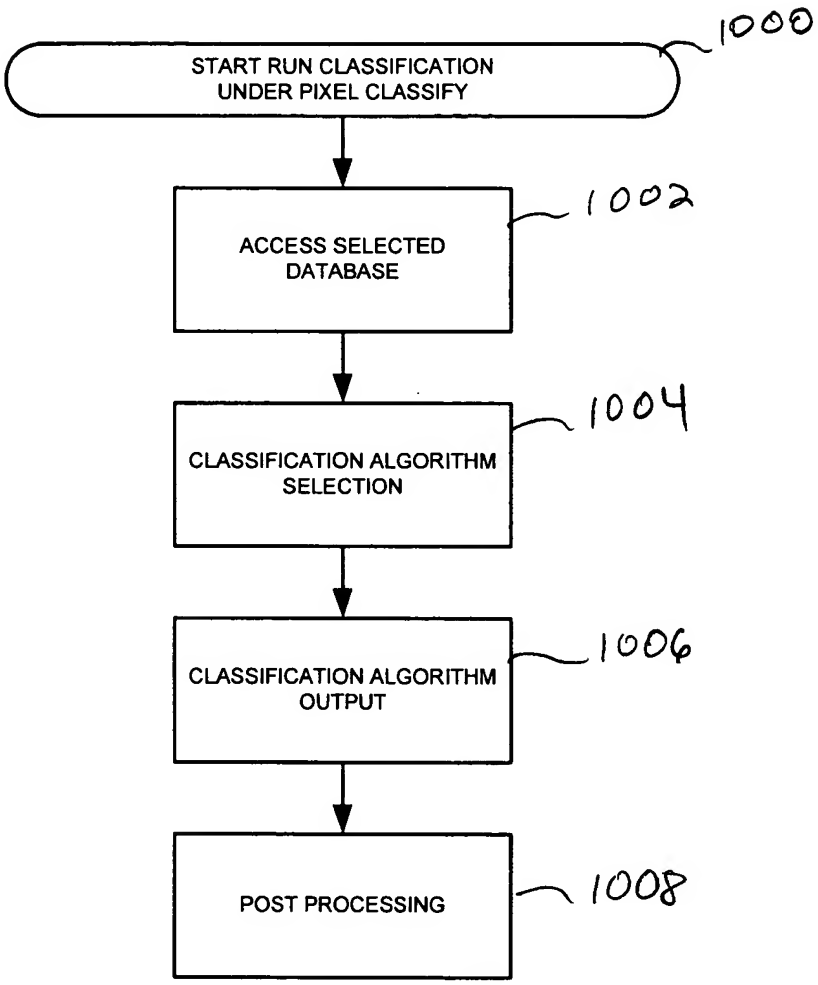
1000
START RUN CLASSIFICATION UNDER PIXEL CLASSIFY
1002
ACCESS SELECTED DATABASE
1004
CLASSIFICATION ALGORITHM SELECTION
1006
CLASSIFICATION ALGORITHM OUTPUT
1008
POST PROCESSING

FIG. 10

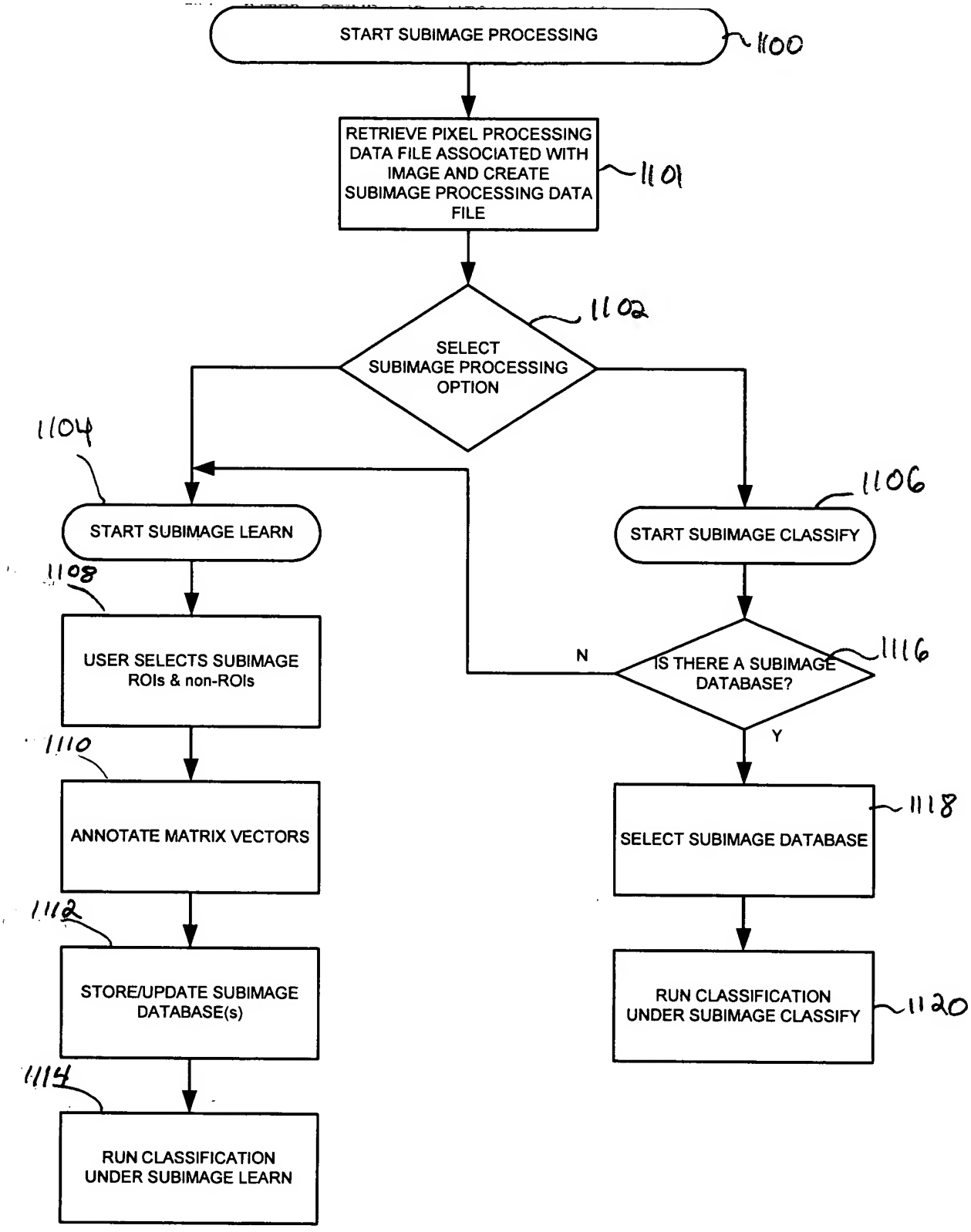
START SUBIMAGE PROCESSING
1100
RETRIEVE PIXEL PROCESSING DATA FILE ASSOCIATED WITH IMAGE AND CREATE SUBIMAGE PROCESSING DATA FILE
1101
SELECT SUBIMAGE PROCESSING OPTION
1102
1104
START SUBIMAGE LEARN
1106
START SUBIMAGE CLASSIFY
1108
USER SELECTS SUBIMAGE ROIs & non-ROIs
N
IS THERE A SUBIMAGE DATABASE?
1116
Y
1110
ANNOTATE MATRIX VECTORS
1118
SELECT SUBIMAGE DATABASE
1112
STORE/UPDATE SUBIMAGE DATABASE(s)
RUN CLASSIFICATION UNDER SUBIMAGE CLASSIFY
1120
1114
RUN CLASSIFICATION UNDER SUBIMAGE LEARN

FIG. 11

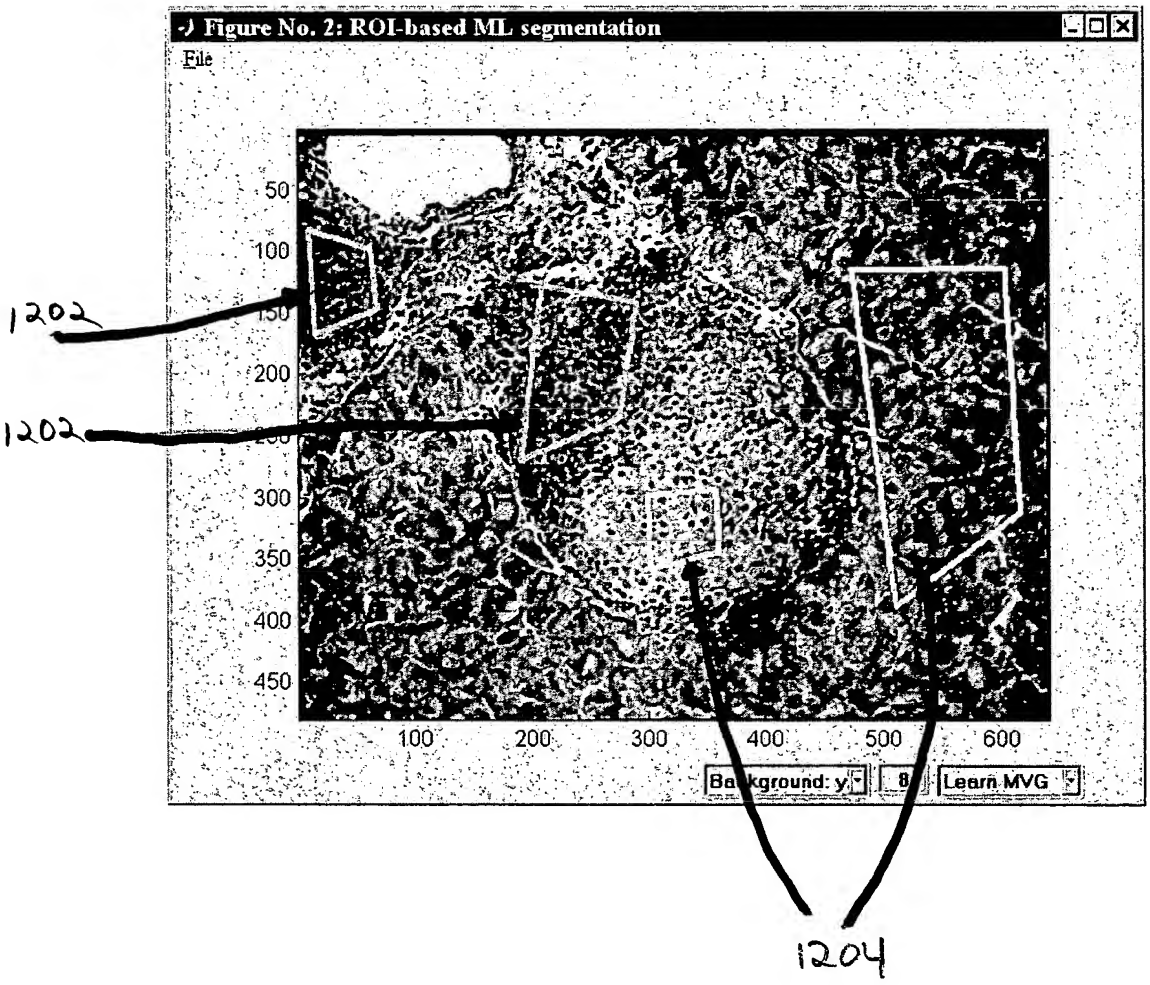
Figure No. 2: ROI-based ML segmentation
File
50
100
150
200
300
350
400
450
100
200
300
400
500
600
Learn MVG
1202
1202
1204

FIG. 12

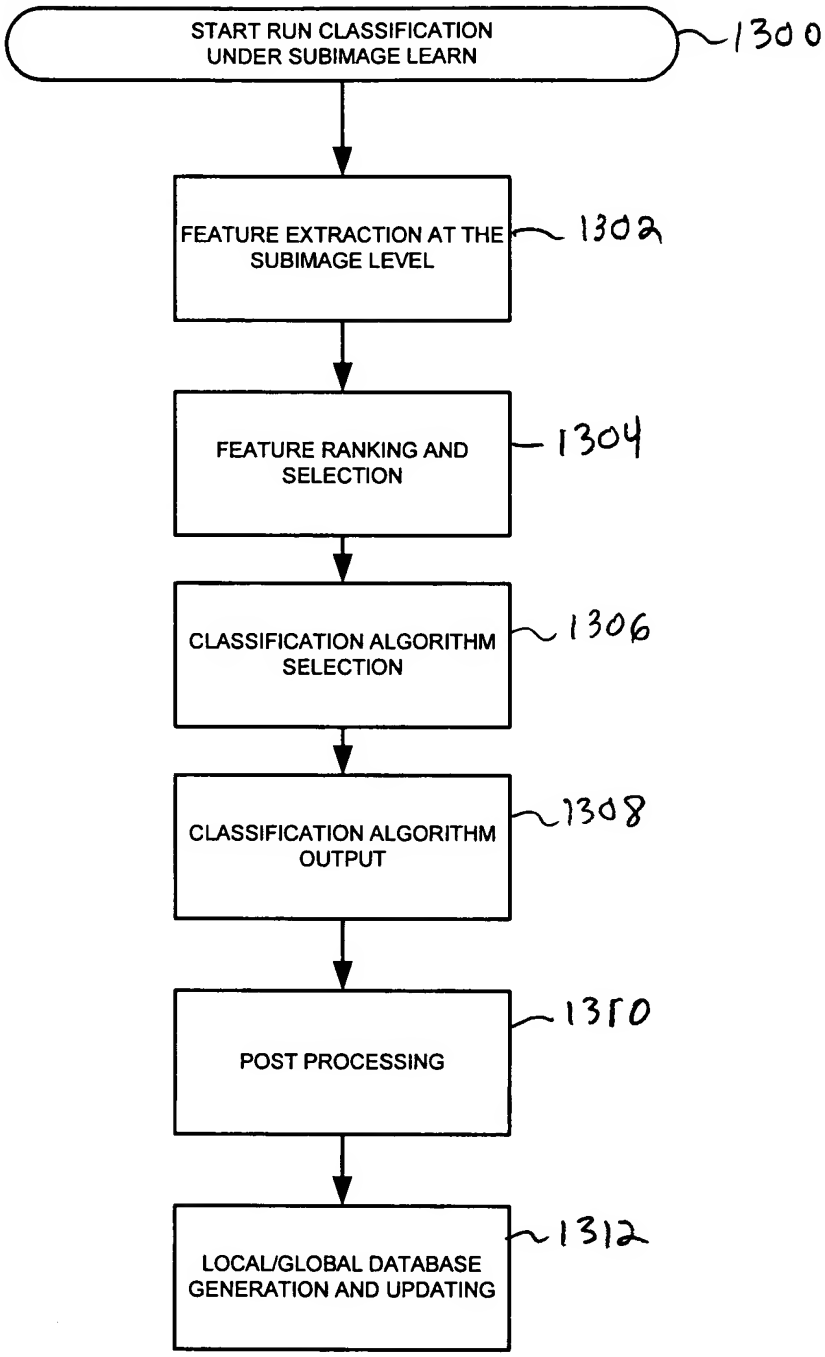
START RUN CLASSIFICATION UNDER SUBIMAGE LEARN
1300
FEATURE EXTRACTION AT THE SUBIMAGE LEVEL
1302
FEATURE RANKING AND SELECTION
1304
CLASSIFICATION ALGORITHM SELECTION
1306
CLASSIFICATION ALGORITHM OUTPUT
1308
POST PROCESSING
1310
LOCAL/GLOBAL DATABASE GENERATION AND UPDATING
1312

FIG. 13

Subimage Processing

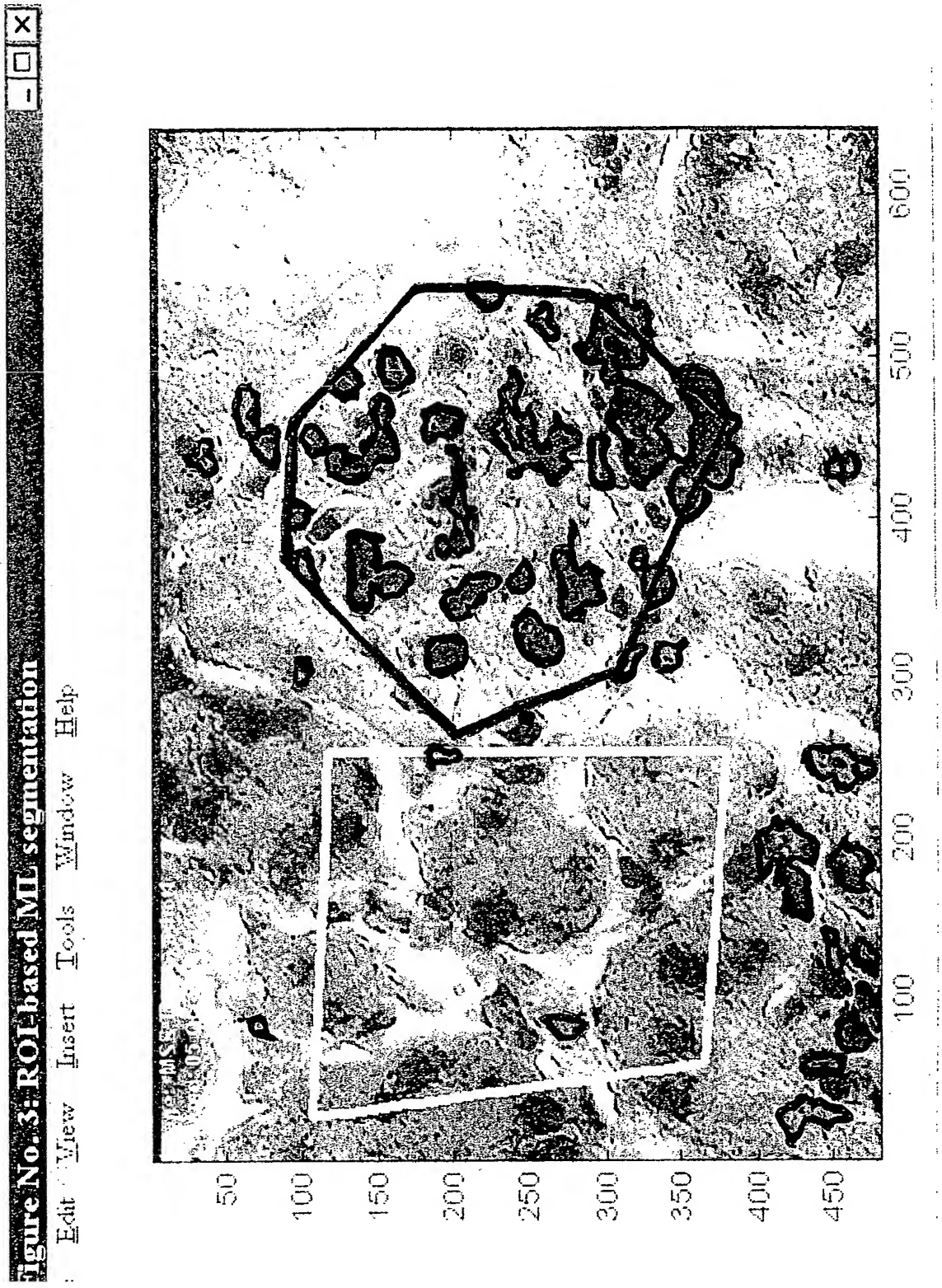

FIG. 14A

Pixel Processing

FIG 14B

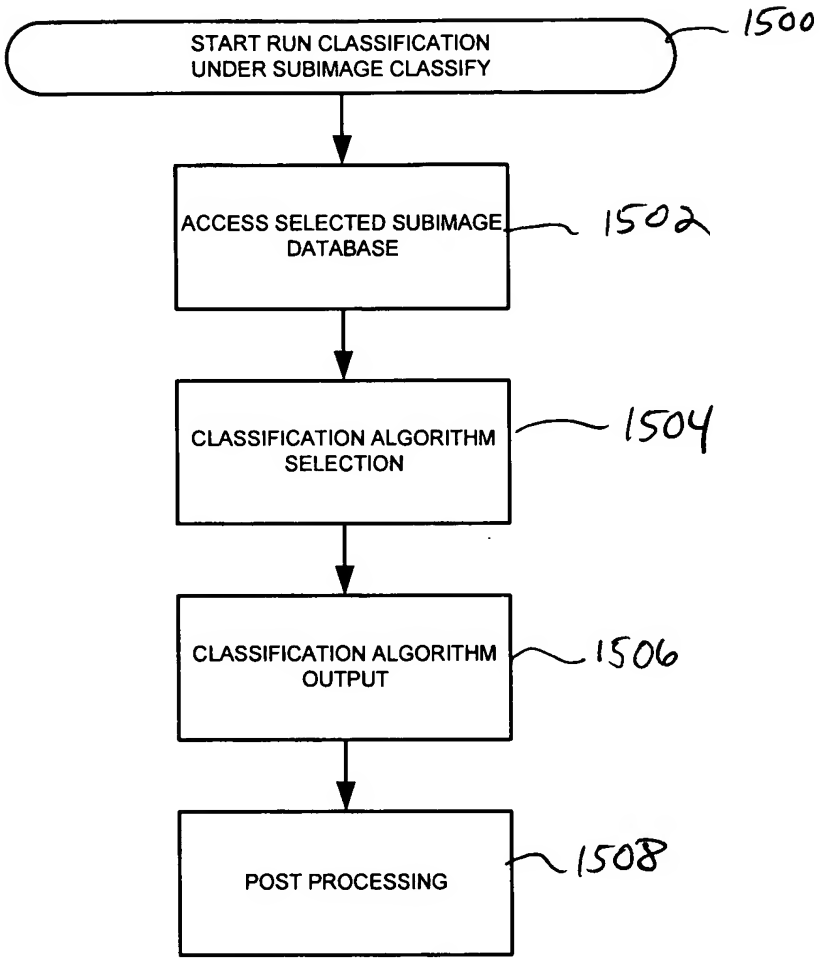
START RUN CLASSIFICATION UNDER SUBIMAGE CLASSIFY
1500
ACCESS SELECTED SUBIMAGE DATABASE
1502
CLASSIFICATION ALGORITHM SELECTION
1504
CLASSIFICATION ALGORITHM OUTPUT
1506
POST PROCESSING
1508

FIG. 15

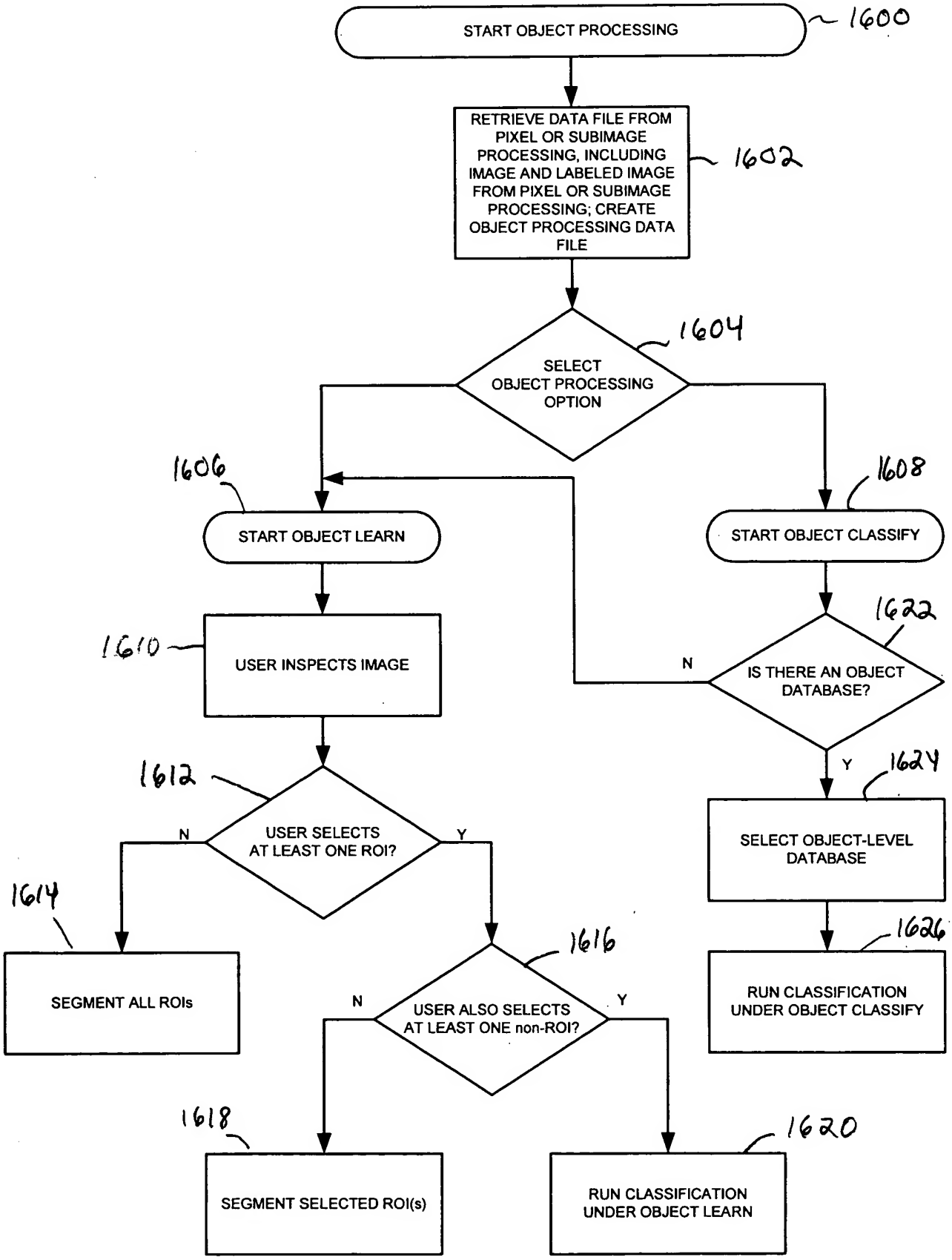
START OBJECT PROCESSING
1600
RETRIEVE DATA FILE FROM PIXEL OR SUBIMAGE PROCESSING, INCLUDING IMAGE AND LABELED IMAGE FROM PIXEL OR SUBIMAGE PROCESSING; CREATE OBJECT PROCESSING DATA FILE
1602
SELECT OBJECT PROCESSING OPTION
1604
1606
START OBJECT LEARN
1608
START OBJECT CLASSIFY
1610
USER INSPECTS IMAGE
1622
IS THERE AN OBJECT DATABASE?
N
Y
1624
SELECT OBJECT-LEVEL DATABASE
1612
USER SELECTS AT LEAST ONE ROI?
N
Y
1614
SEGMENT ALL ROIs
1616
USER ALSO SELECTS AT LEAST ONE non-ROI?
N
Y
1626
RUN CLASSIFICATION UNDER OBJECT CLASSIFY
1618
SEGMENT SELECTED ROI(s)
1620
RUN CLASSIFICATION UNDER OBJECT LEARN

FIG. 16

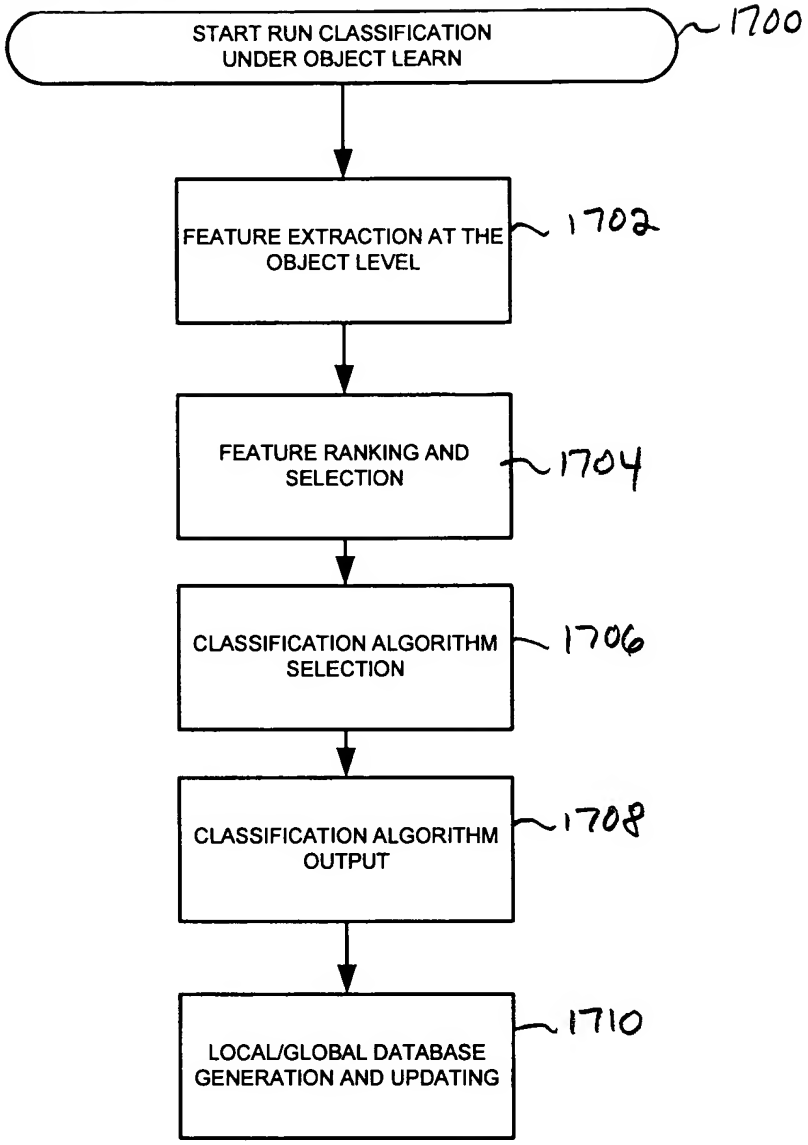
START RUN CLASSIFICATION UNDER OBJECT LEARN
1700
FEATURE EXTRACTION AT THE OBJECT LEVEL
1702
FEATURE RANKING AND SELECTION
1704
CLASSIFICATION ALGORITHM SELECTION
1706
CLASSIFICATION ALGORITHM OUTPUT
1708
LOCAL/GLOBAL DATABASE GENERATION AND UPDATING
1710

FIG. 17

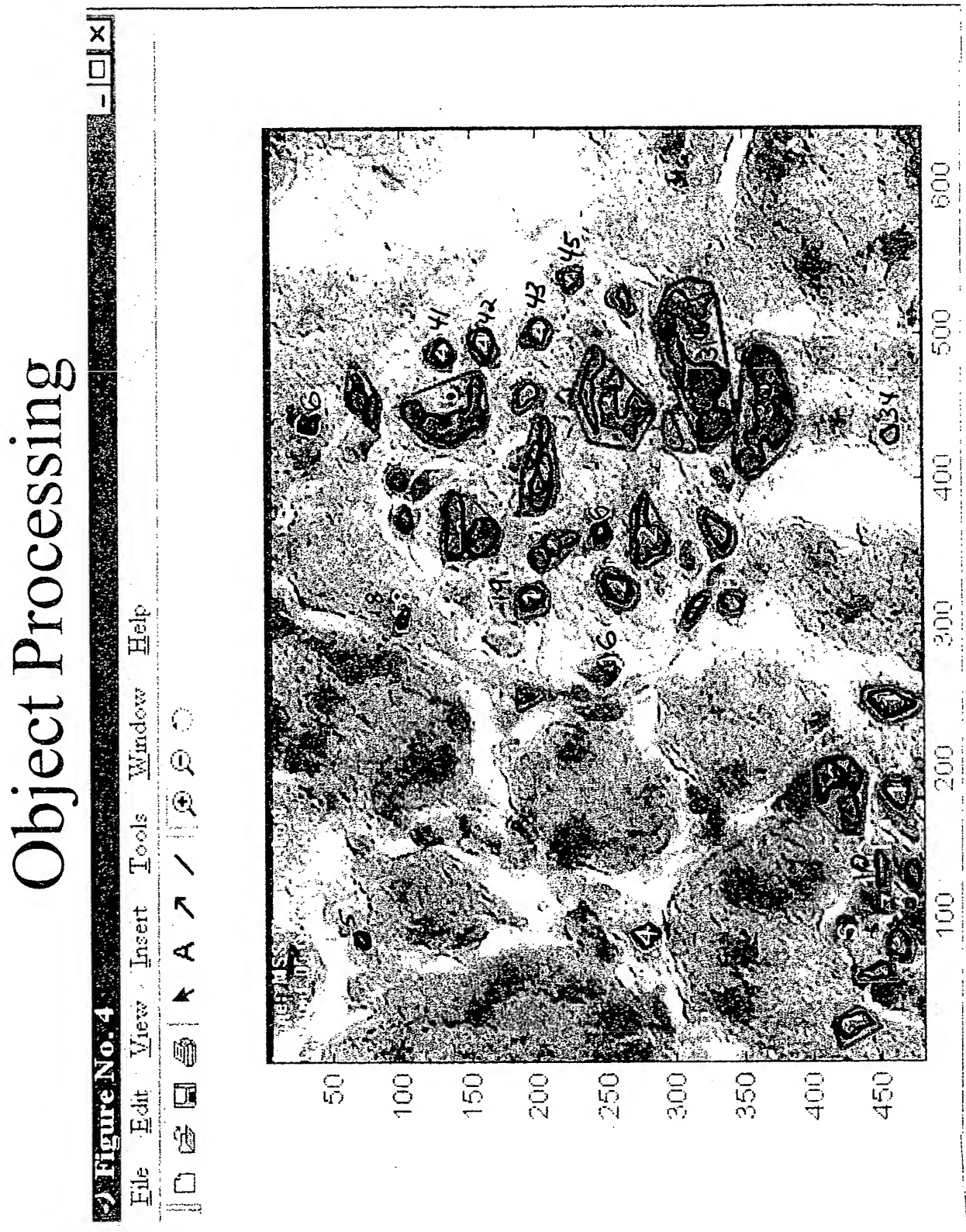
Object Processing
Figure No. 4
File Edit View Insert Tools Window Help
50
100
150
200
250
300
350
400
450
100
200
300
400
500
600

FIG. 18

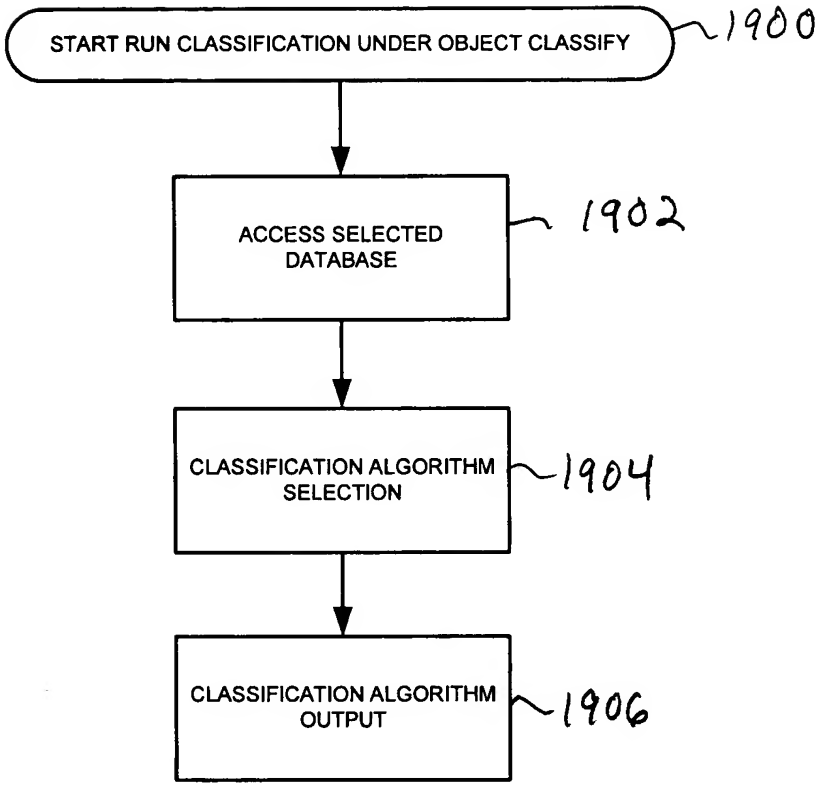
START RUN CLASSIFICATION UNDER OBJECT CLASSIFY
1900
ACCESS SELECTED DATABASE
1902
CLASSIFICATION ALGORITHM SELECTION
1904
CLASSIFICATION ALGORITHM OUTPUT
1906

FIG. 19

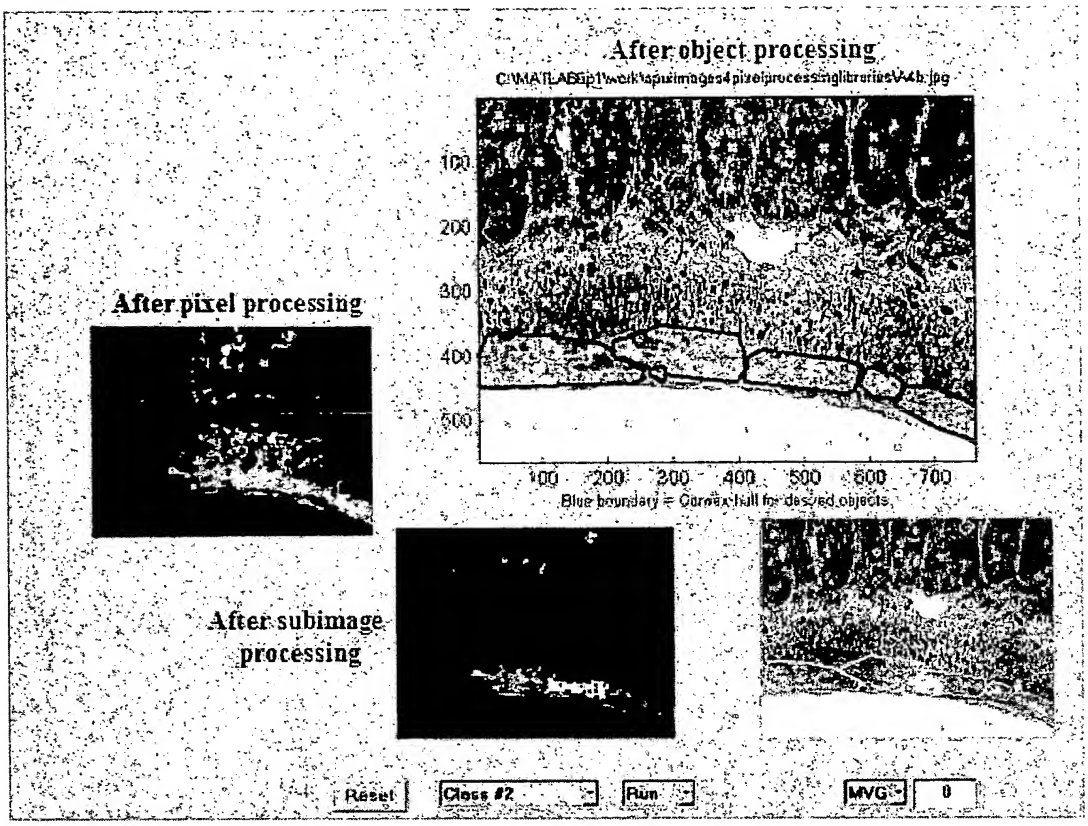
After object processing
C:\MATLAB6p1\work\apuimages4pixelprocessinglibrariesV4b.jpg
100
200
300
400
500
100 200 300 400 500 600 700
Blue boundary = Convex hull for desired objects
After pixel processing
After subimage processing
Reset
Class #2
Run
MVG
0

FIG. 20